

CLAIMS

The embodiments of an invention in which an exclusive property or right is claimed are defined as follows:

- 5 1. A method for modifying at least one synapse of a physical neural network, said method comprising the steps of:

providing a physical neural network comprising at least one neuron and at least one synapse thereof, wherein said at least one synapse is formed from a plurality of nanoparticles disposed within a dielectric solution in association with
10 at least one pre-synaptic electrode and at least one post-synaptic electrode thereof and an electric field applied thereof; and

transmitting at least one pulse generated from said at least one neuron to at least one post-synaptic electrode of a said neuron and said at least one pre-synaptic electrode of said at least one neuron of said physical neural network,
15 thereby strengthening at least one nanoconnection of said plurality of nanoparticles disposed within said dielectric solution and said at least one synapse thereof.

2. The method of claim 1 further comprising the step of:

increasing an electrical frequency of said electric field applied to said at
20 least one pre-synaptic electrode and said at least one post-synaptic electrode, in response to generating said at least one pulse said at least one neuron, thereby strengthening at least one nanoconnection of said plurality of nanoparticles disposed within said dielectric solution and said at least one synapse thereof.

3. The method of claim 1 further comprising the step of:

forming a connection network from said plurality of nanoparticles by applying said electric field to said at least one pre-synaptic electrode and said at least one post-synaptic electrode associated with said plurality of nanoparticles.

5 5. The method of claim 1 wherein said physical neural network comprises an adaptive neural network.

6. A method for strengthening nanoconnections of a physical neural network, said method comprising the steps of:

10 providing a physical neural network comprising a plurality of neurons formed from a plurality of nanoconnections disposed within a dielectric solution in association with at least one pre-synaptic electrode and at least one post-synaptic electrode;

15 activating said subsequent neuron in response to firing an initial neuron of said plurality of neurons, thereby increasing a voltage of a pre-synaptic electrode of said neuron, which causes a refractory pulse thereof to decrease a voltage of a post-synaptic electrode associated with said neuron and thus provides an increased voltage between said pre-synaptic electrode of said preceding neurons and said post-synaptic electrode of said neuron.

7. The method of claim 6 further comprising the steps of:

20 firing and activating subsequent neurons thereof in succession in order to produce an increased frequency of an electric field between subsequent pre-synaptic and post-synaptic electrodes thereof, thereby causing an increase in an alignment of at least one nanoconnection of said plurality of nanoconnections and a decrease in an electrode resistance between said subsequent pre-synaptic and post-synaptic electrodes thereof.

25 8. The method of claim 6 wherein said physical neural network comprises an adaptive neural network.

9. A method for forming an adaptive physical neural network utilizing nanotechnology, said method comprising the steps of:

5 configuring an adaptive physical neural network to comprise a plurality of nanoparticles located within a dielectric solution, wherein said plurality of nanoparticles experiences an alignment with respect to an applied electric field to form a connection network thereof, such that said adaptive physical neural network comprises a plurality of neurons interconnected by a plurality of said nanoconnections; and

10 providing an increased frequency of said applied electric field to strengthen said plurality of nanoparticles within said adaptive physical neural network regardless of a network topology thereof.

10. The method of claim 9 further comprising the step of:

providing at least one output from at least one neuron of said plurality of neurons to an input of another neuron of said adaptive physical neural network.

15 11. The method of claim 9 further comprising the steps of:

automatically summing at least one signal provided by said connection network via at least one neuron of said adaptive physical neural network to provide a summation value thereof;

20 comparing said summation value to a threshold value and emitting a pulse if a current activation state exceeds said threshold value; and

25 automatically grounding or lowering to -Vcc a post synaptic junction associated with said at least one neuron during emission of said pulse, thereby causing at least one synapse in receipt of a pre-synaptic activation to experience an increase in a local electric field, such that at least one synapse that contributes to an activation of said at least one neuron experiences an increase in said local electric field parallel to a connection direction associated with said

connection network and additionally experiences a higher frequency of activation in order to increase a strength of said nanoconnections.

12. The method of claim 9 wherein at least one neuron of said physical neural network comprises an integrator.

5 13. A method for training a physical neural network formed utilizing nanotechnology, said method comprising the steps of:

providing a physical neural network comprising a plurality of neurons connected via a plurality of nanoconductors disposed within a dielectric solution to form at least one connection network of nanoconnections thereof, wherein said
10 nanoconnections transfer signals;

presenting an input data set to said physical neural network to produce at least one output thereof; and

increasing network activity within said physical neural network until said at least one output changes to a desired output.

15 14. The method of claim 13 wherein the step of increasing said network activity within said physical neural network, further comprises the step of:

increasing a number of firing neurons in said physical neural network.

15. The method of claim 13 wherein:

said plurality of neurons comprises a plurality of interconnected neurons
20 that are interconnected by said nanoconnections, each of said nanoconnections being associated with a weight; and

said increasing said network activity within said physical neural network includes scaling a weight associated with said nanoconnections by a positive factor.

16. The method of claim 13 wherein:

said plurality of neurons comprises a plurality of interconnected neurons that are interconnected by nanconnections for transferring signals having a magnitude in a firing state; and

5 said increasing said network activity within said physical neural network includes increasing said magnitude of said signal in said firing state.

17. The method of claim 13, wherein:

10 said plurality of neurons comprises a plurality of interconnected neurons that are interconnected by a plurality of data input neurons thereof adapted to receive respective external signals;

said increasing said network activity within said physical neural network includes increasing a magnitude of said respective external signals.

18. The method of claim 13, wherein:

15 said plurality of neurons comprises a plurality of interconnected neurons, each of said interconnected neurons being configured to fire when a corresponding excitation level thereof is greater than or equal to a threshold; and

said increasing said network activity within said physical neural network includes lowering said threshold.

19. The method of claim 18 further comprising the step of:

20 determining said excitation level of at least one neuron of said plurality of neurons based on a weighted sum of input signals received over respective nanoconnections, said nanoconnections being associated with respective weights; and

adjusting each of said weights when said at least one neuron of said plurality of neurons and a corresponding one of said others of said neurons fire within a prescribed time interval.

20. The method of claim 13 further comprising the step of:

5 increasing said network activity within said physical neural network in response to a signal.

21. The method of claim 20 further comprising the step of:

providing said desired output data; and

10 comparing said desired output data and said output to generate said signal in response if said desired output data is not equal to said output.

22. The method of claim 13 wherein said physical neural network comprises an adaptive neural network.